Claims

What is claimed is:

1. An apparatus for coupling a tubular member to a preexisting structure, comprising:

a first support member including a first fluid passage;

a manifold coupled to the support member including:

a second fluid passage coupled to the first fluid passage including a throat passage adapted to receive a plug;

a third fluid passage coupled to the second fluid passage; and

a fourth fluid passage coupled to the second fluid passage;

a second support member coupled to the manifold including a fifth fluid passage coupled to the second fluid passage;

an expansion cone coupled to the second support member;

a tubular member coupled to the first support member including one or more sealing members positioned on an exterior surface;

a first interior chamber defined by the portion of the tubular member above the manifold, the first interior chamber coupled to the fourth fluid passage;

a second interior chamber defined by the portion of the tubular member between the manifold and the expansion cone, the second interior chamber coupled to the third fluid passage;

a third interior chamber defined by the portion of the tubular member below the expansion cone, the third interior chamber coupled to the fifth fluid passage; and

a shoe coupled to the tubular member including:

a throat passage coupled to the third interior chamber adapted to receive a wiper dart; and

a sixth fluid passage coupled to the throat passage.

2. A method of coupling a tubular member to a preexisting structure, comprising:

positioning a support member, an expansion cone, and a tubular member within a preexisting structure;

injecting a first quantity of a fluidic material into the preexisting structure below the expansion cone; and

injecting a second quantity of a fluidic material into the preexisting structure above the expansion cone.

3. An apparatus, comprising:

a preexisting structure; and

an expanded tubular member coupled to the preexisting structure;

wherein the expanded tubular member is coupled to the preexisting structure by a process comprising:

positioning a tubular support member defining an internal longitudinal passage, an expansion cone, and the tubular member within the preexisting structure;

injecting a first fluidic material through the internal passage of the tubular support member into the preexisting structure below the expansion cone; and

injecting a second fluidic material through the internal passage of the tubular support member into the preexisting structure above the expansion cone.

4. An apparatus for coupling two elements, comprising:

a support member including one or more support member slots;

a tubular member including one or more tubular member slots; and

a coupling for removably coupling the tubular member to the support member, including:

a coupling body movably coupled to the support member;

one or more coupling arms extending from the coupling body; and

coupling elements extending from corresponding coupling arms adapted to mate with corresponding support member and tubular member slots.

5. A method of coupling a first member to a second member, comprising:
forming a first set of coupling slots in the first member;
forming a second set of coupling slots in the second member;
aligning the first and second pairs of coupling slots; and
inserting coupling elements into each of the pairs of coupling slots.

6. An apparatus for controlling the flow of fluidic materials within a housing, comprising:
a first passage within the housing;
a throat passage within the housing fluidicly coupled to the first passage adapted to receive a plug;
a second passage within the housing fluidicly coupled to the throat passage;
a third passage within the housing fluidicly coupled to the first passage;
one or more valve chambers within the housing fluidicly coupled to the third passage including moveable valve elements;
a fourth passage within the housing fluidicly coupled to the valve chambers and a region outside of the housing;
a fifth passage within the housing fluidicly coupled to the second passage and controllably coupled to the valve chambers by corresponding valve elements; and
a sixth passage within the housing fluidicly coupled to the second passage and the valve chambers.

7. A method of controlling the flow of fluidic materials within a tubular housing that defines an inlet passage and one or more outlet passages, comprising:
injecting fluidic materials into the inlet passage;

blocking the inlet passage; and

opening the outlet passages.

8. An apparatus, comprising:

a first tubular member;

a second tubular member positioned within and coupled to the first tubular member;

a first annular chamber defined by the space between the first and second tubular members;

an annular piston movably coupled to the second tubular member and positioned within the first annular chamber;

an annular sleeve coupled to the annular piston and positioned within the first annular chamber;

a third annular member coupled to the second annular member and positioned within and movably coupled to the annular sleeve;

a second annular chamber defined by the space between the annular piston, the third annular member, the second tubular member, and the annular sleeve;

an inlet passage fluidicly coupled to the first annular chamber; and

an outlet passage fluidicly coupled to the second annular chamber.

9. A method of applying an axial force to a first piston positioned within a first piston chamber, comprising:

applying an axial force to the first piston using a second piston positioned within the first piston chamber.

10. An apparatus for radially expanding a tubular member, comprising:

a support member;

a tubular member coupled to the support member;

a mandrel movably coupled to the support member and positioned within the tubular member;

an annular expansion cone coupled to the mandrel and movably coupled to the tubular member for radially expanding the tubular member; and

a lubrication assembly coupled to the mandrel for supplying a lubricant to the annular expansion cone, including:

a sealing member coupled to the annular member;

a body of lubricant positioned in an annular chamber defined by the space between the sealing member, the annular member, and the tubular member; and

a lubrication supply passage fluidicly coupled to the body of lubricant and the annular expansion cone for supplying a lubricant to the annular expansion cone.

11. A method of operating an apparatus for radially expanding a tubular member including an expansion cone, comprising:

lubricating the interface between the expansion cone and the tubular member;

centrally positioning the expansion cone within the tubular member; and

applying a substantially constant axial force to the tubular member prior to a beginning of a radial expansion process.

12. An apparatus, comprising:

a support member;

a tubular member coupled to the support member;

an annular expansion cone movably coupled to the exterior of the support member and the interior of the tubular member for radially expanding the tubular member; and

a preload assembly coupled to the support member for applying an axial force from the support member to the annular expansion cone to preload the

annular expansion cone against the interior surface of the tubular member, including:

a compressed spring coupled to the support member for applying the axial force to the annular expansion cone.

13. An apparatus for coupling a tubular member to a preexisting structure, comprising:

a support member;

a manifold coupled to the support member for controlling the flow of fluidic materials within the apparatus;

a radial expansion assembly movably coupled to the support member for radially expanding the tubular member; and

a coupling assembly for removably coupling the tubular member to the support member.

14. An apparatus for coupling a tubular member to a preexisting structure, comprising:

an annular support member including a first passage;

a manifold coupled to the annular support member, including:

a throat passage fluidicly coupled to the first passage adapted to receive a fluid plug;

a second passage fluidicly coupled to the throat passage;

a third passage fluidicly coupled to the first passage;

a fourth passage fluidicly coupled to the third passage;

one or more valve chambers fluidicly coupled to the fourth passage including corresponding movable valve elements;

one or more fifth passages fluidicly coupled to the second passage and controllably coupled to corresponding valve chambers by corresponding movable valve elements;

one or more sixth passages fludicly coupled to a region outside of the manifold and to corresponding valve chambers;

one or more seventh passages fluidicly coupled to corresponding valve chambers and the second passage; and

one or more force multiplier supply passages fluidicly coupled to the fourth passage;

a force multiplier assembly coupled to the annular support member, including:

a force multiplier tubular member coupled to the manifold;

an annular force multiplier piston chamber defined by the space between the annular support member and the force multiplier tubular member and fluidicly coupled to the force multiplier supply passages;

an annular force multiplier piston positioned in the annular force multiplier piston chamber and movably coupled to the annular support member;

a force multiplier sleeve coupled to the annular force multiplier piston;

a force multiplier sleeve sealing member coupled to the annular support member and movably coupled to the force multiplier sleeve for sealing the interface between the force multiplier sleeve and the annular support member;

an annular force multiplier exhaust chamber defined by the space between the annular force multiplier piston, the force multiplier sleeve, and the force multiplier sleeve sealing member; and

a force multiplier exhaust passage fluidicly coupled to the annular force multiplier exhaust chamber and the interior of the annular support member;

an expandable tubular member;

a radial expansion assembly movably coupled to the annular support member, including:

an annular mandrel positioned within the annular force multiplier piston chamber;

an annular expansion cone coupled to the annular mandrel and movably coupled to the expandable tubular member;

a lubrication assembly coupled to the annular mandrel for supplying lubrication to the interface between the annular expansion cone and the expandable tubular member;

a centralizer coupled to the annular mandrel for centering the annular expansion cone within the expandable tubular member; and

a preload assembly movably coupled to the annular support member for applying an axial force to the annular mandrel; and

a coupling assembly coupled to the annular support member and releasably coupled to the expandable tubular member, including:

a tubular coupling member coupled to the expandable tubular member including one or more tubular coupling member slots;

an annular support member coupling interface coupled to the annular support member including one or more annular support member coupling interface slots; and

a coupling device for releasably coupling the tubular coupling member to the annular support member coupling interface, including:

a coupling device body movably coupled to the annular support member;

one or more resilient coupling device arms extending from the coupling device body; and

one or more coupling device coupling elements extending from corresponding coupling device arms adapted to removably mate with corresponding tubular coupling member and annular support member coupling slots.

15. A method of coupling a tubular member to a pre-existing structure, comprising:

positioning an expansion cone and the tubular member within the preexisting structure using a support member;

displacing the expansion cone relative to the tubular member in the axial direction; and

decoupling the support member from the tubular member.

16. An apparatus, comprising:

a preexisting structure; and

a radially expanded tubular member coupled to the preexisting structure by a process comprising:

positioning an expansion cone and the tubular member within the preexisting structure using a support member;

displacing the expansion cone relative to the tubular member in the axial direction; and

decoupling the support member from the tubular member.

17. The method of claim 7, wherein blocking the inlet passage comprises:

blocking the inlet passage by placing a ball plug into a throat passage defined in the inlet passage.

18. The method of claim 7, further comprising:

conveying the injected fluidic materials radially out of the inlet passage into a plurality of spaced apart longitudinal passages defined in the tubular housing and into an annular chamber defined in the tubular housing that surrounds the inlet passage.

19. The method of claim 18, further comprising:

preventing debris from entering the annular chamber;

20. The method of claim 7, wherein opening the outlet passages comprises:

detecting the operating pressure of the injected fluidic materials; and

if the detected operating pressure of the injected fluidic materials exceeds a predetermined amount, then opening the outlet passages.

21. The method of claim 20, wherein opening the outlet passages comprises:

if the detected operating pressure of the injected fluidic materials exceeds about 500 to 3,000 psi, then displacing valve members positioned within corresponding longitudinal valve chambers defined in the tubular housing to thereby permit fluidic materials within the inlet passage to be conveyed radially out of the tubular housing through the outlet passages.

22. The method of claim 7, further comprising:

controlling the rate at which the fluidic materials are conveyed out of the tubular housing through the outlet passages using variable orifices positioned within and fluidicly coupled to the outlet passages.

23. The method of claim 7, wherein the outlet passages are orthogonal to the inlet passage.

24. The method of claim 7, further comprising:

conveying the injected fluidic materials radially out of the inlet passage into a plurality of circumferentially spaced apart longitudinal passages defined in the tubular housing and into an annular chamber defined in the tubular housing that surrounds the inlet passage; and

conveying the injected fluidic materials into a plurality of circumferentially spaced apart longitudinal valve chambers fluidicly coupled to corresponding outlet passages that each include corresponding movable valve members.

25. The method of claim 24, wherein opening the outlet passages comprises:

if the detected operating pressure of the injected fluidic materials exceeds a predetermined amount, then displacing the valve members positioned within the corresponding longitudinal valve chambers to thereby permit fluidic materials within the inlet passage to be conveyed radially out of the tubular housing through the outlet passages.

26. The method of claim 24, wherein the valve chambers are interleaved among the longitudinal passages.

27. The method of claim 7, wherein blocking the inlet passage comprises:

blocking the inlet passage by placing a ball plug into a throat passage defined in the inlet passage; and further comprising:

conveying the injected fluidic materials radially out of the inlet passage into a plurality of spaced apart longitudinal passages defined in the tubular housing and into an annular chamber defined in the tubular housing that surrounds the inlet passage; and

preventing debris from entering the annular chamber.

28. The method of claim 7, wherein opening the outlet passages comprises:

detecting the operating pressure of the injected fluidic materials;

if the detected operating pressure of the injected fluidic materials exceeds about 500 to 3,000 psi, then displacing valve members positioned within corresponding longitudinal valve chambers defined in the tubular housing to thereby permit fluidic materials within the inlet passage to be conveyed radially out of the tubular housing through the outlet passages; and

controlling the rate at which the fluidic materials are conveyed out of the tubular housing through the outlet passages using variable orifices positioned within and fluidicly coupled to the outlet passages.

29. The method of claim 7, wherein the outlet passages are orthogonal to the inlet passage; and further comprising:

conveying the injected fluidic materials radially out of the inlet passage into a plurality of circumferentially spaced apart longitudinal passages defined in the tubular housing and into an annular chamber defined in the tubular housing that surrounds the inlet passage; and

conveying the injected fluidic materials into a plurality of circumferentially spaced apart longitudinal valve chambers fluidicly coupled to corresponding outlet passages that each include corresponding movable valve members.

30. A method for controlling the flow of fluidic materials within a tubular housing defining an inlet passage for conveying the fluidic materials into the housing and one or more outlet passages for conveying fluidic materials out of the housing, comprising:

injecting fluidic materials into the inlet passage;

blocking the inlet passage by placing a ball plug into a throat passage defined in the inlet passage;

conveying the injected fluidic materials radially out of the inlet passage into a plurality of spaced apart longitudinal passages defined in the tubular housing and into an annular chamber defined in the tubular housing and surrounding the inlet passage;

preventing debris from entering the annular chamber;

detecting the operating pressure of the injected fluidic materials;

if the detected operating pressure of the injected fluidic materials exceeds about 500 to 3,000 psi, then displacing valve members positioned within corresponding longitudinal valve chambers defined in the tubular housing to thereby permit fluidic materials within the inlet passage to be conveyed radially out of the tubular housing through a plurality of outlet passages; and

controlling the rate at which the fluidic materials are conveyed out of the tubular housing through the outlet passages using variable orifices positioned within and fluidicly coupled to the outlet passages.